

REMARKS

Claims 1, 2, 4-9, and 20 are now in the case for examination. Claims 10-17 are withdrawn and will be cancelled upon the allowance of claims.

Support for amended claim 1 can be found in claim 3 as originally filed and paragraphs forty-five and forty-six

The rejection of claim 1-9, and 18-20, under 35 U.S.C. § 103(a) for being unpatentable over Mimura et al., U.S. Patent No. 5,648,053 in view of Izutsu '084 and Gal U.S. Patent No. 5,624,649 and optionally, further in view of Slavid et al U.S. Publication No. 2002/0058164, is respectfully traversed.

The Applicants' invention is directed to a simplified process for the removal of carbon dioxide, and the simultaneous removal of oxidized acid anhydride precursor gases and acid moieties, specifically SO_2 , NO_x , HCl and HF . The Applicants' process provides for the cooling of flue gases containing CO_2 , acid anhydride precursors, and acid moieties, removing particulate, oxidizing the precursors and simultaneously converting the oxidized acid anhydrides precursors and other acid moieties to ammonia salts by reaction with ammonia-containing compounds and then converting carbon dioxide to an ammonia salt. Ammonia-containing compounds used with the Applicants' invention are inorganic compounds which are formed from the reaction of ammonia, NH_3 , with inorganic salts. Examples of ammonia compounds for use with the Applicants' invention are given in the last sentences of paragraphs 44 and 46. The aqua ammonia compounds of Applicants' invention do not utilize amines, which are organic compounds derived from ammonia. Further, Applicants' invention is directed to removal of selected acid anhydride precursors. The prior art suggests the removal of selected components, not the simultaneous conversion and collection of acid anhydride precursors and

acid moieties. The references cited by the Examiner do not suggest the removal of CO₂ from flue gases with the use of ammonia-containing (NH₃-containing) compounds.

Mimura et al., is directed to a process for removing both CO₂ and NO_x by bringing the gases into contact with an aqueous solution of an alcoholic hydroxyl-containing secondary or tertiary-amine solution. Amines are derivatives of ammonia in which one or more of the hydrogens have been replaced by an alkyl or aryl group (Typically designated by R in organic chemistry nomenclature). A secondary amine refers to two of the hydrogens in an ammonia molecule having been replaced by hydrocarbon groups. Tertiary amine refers to replacement of three hydrogens from ammonia with hydrocarbon groups. While both ammonia and amines contain nitrogen, amines are organic chemical compounds that are chemical distinct from the inorganic ammonia compounds for use with the Applicants invention. As noted in paragraph eight of the present application, amines have a limited lifetime due to degradation through oxidation of the amine. This is distinguished from ammonia, which as noted in paragraph forty-nine of the application, which has little degradation of the ammonia itself. Further, Mimura do not teach the simultaneous conversion of oxidized acid anhydrides precursors and acid moieties, which includes HCl, HF and to ammonia salts and the subsequent conversion of carbon dioxide to an ammonia salt. Further, Mimura do not suggest the use of aqua ammonia in the removal process. The Applicants argue that the invention of claims 1, 2, 4-9 and 20 is novel and unobvious over Mimura, U.S. Patent No. 5,648,053.

As previously discussed, Izutsu et al., U.S. Patent 6,355,084, is directed to the production of a fertilizer by injecting ammonia into and applying an electron beam to a gas containing sulfur oxides. Izutsu does not teach the simultaneous conversion of oxidized acid anhydrides precursors and acid moieties, which includes HCl and HF, to ammonia salts and

the subsequent conversion of carbon dioxide to an ammonia salt. Further, Izutsu does not suggest the use of aqua ammonia in the removal process. The Applicants argue that the invention of claims 1, 2, 4-9, and 20 is novel and unobvious over Izutsu, U.S. Patent No. 6,355,084.

As Izutsu removal process utilizes ammonia, while Mimura's process utilizes an aqueous solution of an alcoholic hydroxyl-containing secondary or tertiary-amine solution, the two processes do not utilize the same reactants. As discussed hereinabove, in connection with the Mimura reference, ammonia compounds are chemically distinct from amines, therefore, Applicants argue that there is no basis for substituting the inorganic compound of one reference for the organic compound of the second reference. Applicants can find no basis for combining these references. Further, even if these references were combined, they would not result in the Applicants' invention, a process providing for the cooling of flue gases containing CO₂, acid anhydride precursors, and acid moieties, removing particulate, oxidizing the precursors and simultaneously converting the oxidized acid anhydride precursors and other acid moieties to ammonia salts and then converting carbon dioxide to an ammonia salt. As neither reference, alone nor in combination, suggests or discloses the unique set of gaseous impurities removed or Applicants' unique reactant, the Applicants argue that the invention of claims 1, 2, 4-9, and 20 is novel and unobvious over the combination of Mimura and Izutsu.

Gal is directed to the removal of sulfur dioxide from flue gases by reacting an ammonia-based solution with the flue gas. Gal discloses that ammonia chloride and ammonium fluoride may be removed from gases containing hydrogen chloride and/or hydrogen fluoride. Gal does not suggest the removal of CO₂ or NO_x from the gas stream with his process. Further, as discussed hereinabove in connection with the Mimura reference, ammonia compounds are

chemically distinct from amines, therefore, Applicants argue that there is no basis for substituting the inorganic compound of one reference for the organic compound of the second reference. Therefore, there is no basis for combining the two references. Contrary to the Examiner's position, Applicants argue that ammonia compounds (NH_3) are chemically distinct from amines (RNH_2 , R_2NH and R_3N). Applicants can find no basis for combining these references. As Gal does not suggest or disclose the unique set of gaseous impurities removed or Applicants' unique reactant, the Applicants argue that the invention as now claimed is novel and unobvious over Gal.

Slavid et al. U.S. Publication No 2002/0058164 is directed to the protection of calcareous building material by the application of an aqueous solution of hydroxycarboxylic acid. Slavid discloses in paragraph 0003 that sulphur dioxide is oxidized by ozone and nitrogen oxides. As Slavid do not disclose or suggest the elements of the Applicants' invention, the Applicants argue that their invention is novel and unobvious over Slavid.

While some of the references suggest individual facets of the Applicants' invention, the references provide no basis for combining the references. Absent the Applicants' application, there is no basis within the referenced for the selection of certain aspects of the references while neglecting other teachings of the references. The Applicants argue that the invention, as now claimed, is novel and unobvious over the combination of Mimura in view of Izutsu and Gal and optionally further in view of Slavid.

In addition, in like manner to the limitations of claim 1, wherein gaseous anhydrides are oxidized to higher gaseous acid anhydrides of claim 2; further wherein the ammonia-containing compounds are water-soluble compounds selected from the group consisting of aqueous ammonia, ammonium hydroxide, ammonium carbonate, ammonium carbamate, and

combinations thereof in claim 4; wherein the ammonia-containing compounds are regenerated by the thermal decomposition of ammonium bicarbonate (NH_4HCO_3) to carbon dioxide (CO_2), ammonia solution (NH_4OH), ammonium carbonate ($(\text{NH}_4)_2\text{CO}_3$), and combinations thereof of claim 5; wherein the process is carried out at temperatures of from about 15°C to 50°C in claim 6; wherein the regeneration is carried out at a temperature from about 35°C to 80°C of claim 7; wherein ammonia generated from the decomposition of ammonium bicarbonate is recycled for use in the converting step of claim 8; wherein the other acid moieties are hydrogen halides of claim 9 and the regenerating the ammonia-containing compounds of claim 20 are unobvious over Mimura in view of Izutsu '084 and Gal and optionally in view of Slavid.

CONCLUSION

The Applicants believe that the application, including claims 1, 2, 4-9, and 20, is now in allowable form. Allowance is therefore respectfully requested.

Respectfully submitted,

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